



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :  
Hironori OSUGA :  
Serial No. 10/808,483 : Group Art Unit: 1712  
Filed: March 25, 2004 : Examiner: R. Sellers  
For: EPOXY RESIN COMPOSITION  
AND SEMICONDUCTOR  
APPARATUS :  
:

D E C L A R A T I O N

Commissioner for Patents  
Alexandria VA 22313-1450

Sir:

I, Shigeyuki MAEDA, declare that I am a citizen of Japan, residing Utsunomiya-shi, Tochigi, Japan, declare:

That I graduated from Department of Applied Chemistry, Faculty of Engineering, Utsunomiya University in March 1993.

That I entered SUMITOMO BAKELITE Co., Ltd. in April 1993, and was engaged in the study of flexible printed circuits from 1993 to 1995, and since 1995, have been engaged in the study of epoxy molding compounds.

That I am familiar with the present invention and the prosecution history of the present application.

That I have carried out the following experiments in order to demonstrate the unexpected superiority of the invention of the above-identified application to the prior art.

### I. Experiment

The same procedures as in Example 2 of the present application were repeated except that the amounts of the components were changed as shown in Table I below and soldering resistance was evaluated as follows.

In the same manner as in the measurement of warpage of package, a 225 pBGA was molded, and this was post-cured at 175°C for 2 hours to obtain 10 samples, each. Each 10 samples were subjected to treatment at a temperature of 60°C and a relative humidity of 60% for 120 hours, and then subjected to an IR reflow treatment wherein peak temperature was 260°C and temperatures not lower than 255°C was maintained for 10 seconds.

Occurrence of delamination and cracking inside the package was examined by an ultrasonic detector. When the number of rejected packages in which cracking and delamination were observed was  $n$ , this is shown by  $n/10$ .

Table I

	Additional Experiment				
	1	2	3	4	5
O-Cresol novolak epoxy resin	5.3	7.9	4.6	10.6	2.0
Phenolic novolak resin	2.7	4.1	2.4	5.4	1.0
Spherical alumina 1	90.0	86.0	91.0	82.0	95.0
Ultrafine silica 1 (specific surface area 180 m <sup>2</sup> /g)	0.5	0.5	0.5	0.5	0.5
Polyorganosiloxane represented by the formula (1)	1.0	1.0	1.0	1.0	1.0
Triphenylphosphine	0.1	0.1	0.1	0.1	0.1
Carbon black	0.2	0.2	0.2	0.2	0.2
Carnauba wax	0.2	0.2	0.2	0.2	0.2
Spiral flow (cm)	130	172	119	200	38
Thermal conductivity (W/mk)	3.5	3.1	3.6	2.6	4.0
Warpage of package (μm)	80	100	72	158	*
Length of flash (mm)	<1.0	1.4	<1.0	3.5	*
Temperature cycle property: The number of rejected packages after 500 cycles	0/10	1/10	0/10	10/10	*
Temperature cycle property: The number of rejected packages after 1000 cycles	1/10	4/10	0/10	10/10	*
Solder resistance: The number of rejected packages	0/10	1/10	0/10	8/10	*

\*: immeasurable because of failure in being charged into the mold

## II. Results

As shown in the above table, Additional Experiments 1, 2 and 3, in which the amount of the spherical alumina is within the presently claimed range, are excellent in the thermal conductivity, warpage of package, length of flash, temperature cycle property and soldering resistance. Additional Experiment 4, in which the amount of the spherical alumina is lower than the presently claimed range, is poor in the thermal conductivity, warpage of package, length of flash, temperature cycle property and soldering resistance. Additional Experiment 5, in which the amount of the spherical alumina is higher than the presently claimed range, is good in the thermal conductivity, but extremely poor in flowability (spiral flow) so that warpage of package, length of flash, temperature cycle property and soldering resistance could not be evaluated because of failure in being charged into the mold.

As is clear from the above results, the present invention attains the superiority which cannot be expected from the prior art.

The undersigned declarant declares further that all statements made herein of own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 12th day of February 2007.

S. Maeda

Shigeyuki MAEDA